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(54) IMPROVEMENTS RELATING TO CHARACTER DISPLAY

(71) We, MULLARD LIMITED, of Abacus House, 33 Gutter Lane, London E.C.2., a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to systems for generating coded pulse data corresponding to alpha-numeric characters and the display of alpha-numeric characters in response to the receipt of such data.

In such systems the display may, for example, be effected by a line raster scan (typically on the screen of a cathode ray tube (C.R.T.)) in response to input data which comprises a serial data stream including successive pulse groups which represent characters and each of which consists of a plurality of pulses. However, the invention is also applicable to parallel data inputs and rasterless displays.

Typically, the pulses of pulse groups can be organised in a simple "on/off" binary code in which a data pulse corresponds to "1" and no pulse corresponds to "0". In this way, 128 different characters can be represented by 7-bit pulse groups.

A decoding arrangement for processing such input data can comprise a memory device in which received input data is stored, together with a character generator which is responsive to the stored input data to produce character generating data which is used to modulate a video signal for a C.R.T. display system to effect the character display.

Where input data represents a plurality of characters which form a message or text to be displayed, it becomes necessary to separate individual words by spaces in conventional manner in order to render the message or text readily legible. A convenient way of identifying the space between two words is to include in the input data a special pulse group which defines the space. Such a special pulse group can

therefore be said to represent a "space" character.

The manner of presentation of a displayed message or text can be enhanced in several ways, e.g. by using different colours for different words, in the case where the display is on a colour C.R.T.; by making a certain word or words of a text "flash"; and, in a case for example where a message or text is to be superimposed on an existing television picture, by providing in the picture a blank "window" in which the message or text is located. However, the information required in the decoding arrangement for determining such display enhancement requires additional data occupying additional time or bandwidth.

It is a principal object of the invention to overcome the latter limitation.

According to its first aspect the invention provides a system comprising means for generating alpha-numeric character data in the form of pulse groups which represent characters in coded form and each of which consists of a plurality of pulses said data including a number of different pulse groups serving both as control characters for determining display enhancement of a particular character, word or words spatially following the control character when displayed and also serving as space characters which define spaces between successive words of a text when displayed, the system also comprising display apparatus for displaying alpha-numeric characters in response to the input of such data and for utilizing said control pulse groups both for determining display enhancement of a particular character, word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.

According to a second aspect the invention provides alpha-numeric character data generating apparatus for use in a system as claimed in Claim 1 including means for generating data in the form of

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pulse groups which represent characters in coded form and each of which consists of a plurality of pulses, and means for coding said control pulse groups in such manner as to adapt them both for determining display enhancement of a particular word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.

According to a third aspect of the invention provides alpha-numeric character display apparatus for use in a system as claimed in Claim 1 including means for receiving input data in the form of pulse groups which represent characters in coded form and each of which consists of a plurality of pulses, means for displaying alpha-numeric characters in response to the input of such data, and means for utilizing said control pulse groups both for determining display enhancement of a particular character, word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.

Although the use of "control" characters in accordance with the invention may reduce the number of different pulse groups (of a given number of pulses) which are available to represent characters, this reduction is thought to be more than compensated for by the fact that no extra transmission time is required in the input data for the "control" characters. This latter aspect affords significant advantages where the transmission time for the input data, and thus the amount of message information which the input data contains, is restricted, for instance in the proposed "teletext" television transmission system for transmitting message information within a broadcast television video signal where the input data is transmitted on television lines during the vertical blanking interval between successive television fields where no normal picture information is present.

In further considering the nature of the present invention, reference will now be made by way of example to the accompanying drawing which shows diagrammatically a television receiver arrangement for displaying selectively either a television picture which is produced from a normal broadcast or cable television video signal, or message information which is transmitted within such signal during vertical blanking periods.

Referring to the drawing, the incoming television video signal appears at an input lead 1 of the television receiver arrangement via the front end E of the arrangement comprising the usual tuning and amplifying circuits. The latter may be coupled to a transmitter T via a conventional over-air or cable link L and

the transmitter T includes means for generating video and teletext data in a manner known except for the provision of combined control and space characters in accordance with the invention.

For normal picture display in the receiver, the video signal is applied via a selector switch 2 and a blanking circuit 3 (to be considered later) to a colour decoder 4 which produces the R, G and B component signals for the picture display, these component signals being applied via video interface circuits 5 to the red, green and blue guns respectively of a colour C.R.T. (not shown). Input data representing message information on the video signal does not affect the picture display because it is located on lines in the vertical blanking period which are not displayed (most of said lines could thus be used but at present it is proposed to restrict such use to lines 17-18 and 330-331 of a 625 line system).

The video signal on the input lead 1 is also applied to a data acquisition circuit 6. It is assumed that the input data contained in the video signal represents message information that is divided into different pages of information, and that each page is for display as a whole on the screen of the C.R.T., with the input data representing each page being repeated periodically with or without updating of the message information. It is further assumed that each page of message information is identifiable by means of a unique page address code which is included in the input data and defines the page number. Thus, the television receiver arrangement includes a page selector circuit 7 which controls the particular input data that is acquired by the circuit 6. (This is indicated by a broad-arrow connection representing the presence of 22 parallel channels carrying 22 bits of information required for page selection; other groups of parallel channels will be similarly represented with the respective numbers of channels and bits of information). The acquired input data is fed from the circuit 6 to a memory device 8 (7 bits for each character). The memory device 8 has a capacity for storing a complete page of message information. In a typical Teletext case each page of message information contains up to 24 rows of characters, with each row containing up to 40 characters. In order to identify the different character rows of a page, it is furthermore assumed that the input data also includes a row address code for each character row (this code employs 10 bits and is fed to the memory 8 as represented schematically by a separate link between units 6 and 8).

In view of the restricted transmission time which is available for the input data

representing message information, for instance, sufficient time to transmit the input data for only one character row during a television line in the vertical blanking interval, the input data for a page of message information has to be stored row-by-row in the memory device 8 over a relatively large number of television fields. This storing of the input data row-by-row in the memory device 8 is under the control of the row address codes received from the data-acquisition circuit 6.

A character generator 10 of the arrangement is responsive to the input data stored in the memory device 8 to produce character generating data i.e. to produce a signal which is effectively a new video signal for displaying the characters of the coded stored information. As mentioned previously, different characters can be represented by respective 7-bit pulse groups. The bits of each pulse group are fed in parallel from the memory device 8 to the character generator 10.

A simple character format for characters to be displayed is a co-ordinate matrix composed of 35 discrete elements arranged in 7 rows and 5 columns, this format being derived from a "read-only" memory which serves as the character generator 10 and which provides 35 bits of character generating data in 7 rows and 5 columns, one row at a time. With such a "read-only" memory, and a 7-bit character code, character generating data pertaining to 128 different characters can be produced selectively in response to appropriate input data. Since the character generating data is required as a modulation of a video signal in order to produce selective bright-up of a C.R.T. screen to achieve character display, the character generating data is produced serially (as 1's and 0's) by using a parallel-to-serial converter 11 to convert each row of 5 bits of data read out from the character generator 10 into serial form.

In order to effect character display on a C.R.T. screen using standard line and frame scans, the logic of the arrangement is so organised that for each row of characters to be displayed, all the characters of the row are built up television line-by-television line as a whole, and the rows of characters built up in succession. Thus, it would take 7 television lines to build up one row of characters. In the first television line, input data from the memory device 8 of the character generator 10 would cause the latter to produce character generating data in respect of the first row of discrete elements for the first character of the row, then in respect of the first row of discrete elements for the second character, and so on for the successive characters of the row. In the second television line character

generating data in respect of the second row of discrete elements for each character of the row would be produced in turn, and so on for the remaining five television lines.

The logic of the arrangement is organised by means of a clock pulse and timing pulse chain circuit 12 which provides appropriate clock and timing pulses to the memory device 8 and the character generator 10. The circuit 12 is synchronised in operation with the scanning circuits of the C.R.T. screen by line and field synchronising pulses which are extracted from the incoming video signal by a sync. separator circuit 13.

In order to respond to information for display enhancement as provided in the input data in the form of pulse groups which serve both as "space" characters and as "control" characters, the television receiver arrangement includes a "control" character detection circuit 14 to which the bits of each pulse group fed in parallel from the memory device 8 to the character generator 10 are also applied. The logic of the character generator 10 treats these pulse groups as pertaining only to "space" characters so as to provide spaces between individual words of a displayed text as message. The circuit 14, on the other hand, identifies these pulse groups according to their particular codes to produce colour, flash and/or window control signals.

In the case of colour control, three colour control R, G and B are provided and are fed to a colour control circuit 15. The character generating data output from the character generator 10 is applied via unit 11 and a selector circuit 16 and a selector switch 17 to the colour control circuit 15 which is responsive to produce R', G' and B' component signals for coloured character display, these component signals being fed to the video inter-face circuits 5. Character display in white is assumed at the start of each row of characters in order to economize in control data (this applies also to the flash and window examples).

Thus a "control" character in the first character position of a row can serve simply as a "space" character or can serve also to determine what colour the row of characters is to be displayed in. A "control" character in a "space" character position intermediate the row can serve to change the remaining characters in the row to a different colour. Also, a single word, or several words, can be given a colour different from the remainder of the row using "control" characters to start and end a colour change.

A flash control signal F provided by the circuit 14 is fed to a flash control circuit 18, the output from which is applied to the

selector circuit 16. In conjunction with the circuit 18 there is provided a multivibrator 19 which feeds an AND-gate 20. The character generating data output from the character generator 10 is also applied to the AND-gate 20 which is thus responsive to reproduce this output as a "flashing" output. This "flashing" output, which can have for example a one second period, can be selected by the circuit 18 in the selector circuit 16 in place of the "steady" output. Start flash "control" characters and end flash "control" characters in appropriate "space" character positions therefore provide flashing of certain parts of a displayed message or text. The colour control can also be effective at the same time.

A window control signal W provided by the circuit 14 is fed to a window control circuit 21, the output of which is applied to the blanking circuit 3 to blank the normal picture information until the termination of the signal W and thereby provide a "window" in which characters can be displayed. Such a "window" can be used for, say, superimposing sub-titles or captions onto a television picture. The output from the circuit 21 to the blanking circuit 3 is applied via a selector switch 22 which is ganged to the selector switch 17 so that a window contact be produced unless character display has been specifically selected.

In order to reduce the tendency for a "window" to be opened spuriously during the display of picture information due to "noise" signals which might stimulate an open window "control" character, it is preferable to arrange for the circuit 14 to detect at least two successively produced "control" characters located in immediately adjacent character positions before the signal W can be produced (this preparation can also be applied to flash and colour enhancement but is less likely to be necessary). Two successively produced close window "control" characters can also be provided for terminating the signal W to close the window, but in this latter instance it is preferable for the circuit 14 to be arranged to respond to either signal, not both, to actually terminate the signal W.

The logic sequence provided by the clock and timing pulses from the circuit 12 introduces predetermined delays between the output from the memory device 8, the output from the character generator 10 and the output from the control character detection circuit 14, appropriate for allowing the control signals R, G, B, F and W to perform their control functions prior to the display of the characters to which these control functions pertain.

In addition to alpha-numeric characters

the system may cater for special symbols and/or for variously oriented segments which can be linked in rows in any desired configuration to display diagrams which may occupy parts of selected pages or even entire selected pages inserted between pages of text.

WHAT WE CLAIM IS:—

1. A system comprising means for generating alpha-numeric character data in the form of pulse groups which represent characters in coded form and each of which consists of a plurality of pulses, said data including a number of different pulse groups serving both as control characters for determining display enhancement of a particular character, word or words spatially following the control character when displayed and also serving as space characters which define spaces between successive words of a text when displayed, the system also comprising display apparatus for displaying alpha-numeric characters in response to the input of such data and for utilizing said control pulse groups both for determining display enhancement of a particular character, word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.

2. A system as claimed in Claim 1 forming part of a television system wherein the alpha-numeric character data generating means are located at the television transmitter and the display apparatus is located in the television receiver.

3. A system as claimed in Claim 2 adapted to transmit and receive the character data during the vertical blanking periods of the video signal.

4. Alpha-numeric character data generating apparatus for use in a system as claimed in Claim 1 including means for generating data in the form of pulse groups which represent characters in coded form and each of which consists of a plurality of pulses, and means for coding said control pulse groups in such a manner as to adapt them both for determining display enhancement of a particular word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.

5. Apparatus as claimed in Claim 4 forming part of a television system wherein the alpha-numeric character data generating means are located at the television transmitter.

6. Apparatus as claimed in Claim 5 adapted to transmit the character data during the vertical blanking periods of the video signal.

7. Alpha-numeric character display

- apparatus for use in a system as claimed in Claim 1 including means for receiving input data in the form of pulse groups which represent characters in coded form and each of which consists of a plurality of pulses, means for displaying alpha-numeric characters in response to the input of such data, and means for utilizing said control pulse groups both for determining display enhancement of a particular character, word or words of a displayed text and also as space characters which define spaces between successive words of the displayed text.
8. Display apparatus as claimed in Claim 7 adapted to form part of a receiver of a television system.
9. Display apparatus as claimed in Claim 8 adapted to receive the character data during the vertical blanking periods of the video signal.
10. Display apparatus as claimed in Claim 9 adapted to control the display of the character data on a display device of the line-scanning type.
11. Display apparatus as claimed in any of Claims 7 to 10 adapted to detect at least two successive control characters in adjacent character positions and adapted to apply this as a criterion for carrying out an enhancement control operation.
12. Display apparatus as claimed in any of Claims 7 to 11 adapted to apply enhancement in the form of a window location of the displayed characters.
13. Display apparatus as claimed in any of Claim 7 to 12 adapted to apply enhancement in the form of flashing.
14. Display apparatus as claimed in any of Claims 7 to 13 suitable for a colour television receiver and adapted to apply enhancement in the form of colour differentiation.
15. Display apparatus substantially as described with reference to the accompanying drawing.
16. Display apparatus as claimed in any of Claims 10 to 15 including a display device in the form of a cathode-ray tube system.
17. A television receiver including display apparatus as claimed in any of Claims 7 to 16.
18. Apparatus substantially as described with reference to the accompanying drawing.
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